SYNTROPHIC ACETATE OXIDATION AT HALOALKALINE CONDITIONS

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Syntrophic acetate oxidation (SAO) is a process where syntrophic acetate-oxidizing bacteria (SAOB) convert acetate to form CO_2 and reducing equivalents. These reducing equivalents are utilized by a syntrophic partner which in most cases is a hydrogenotrophic methanogen or sulfate-reducing bacterium. Until now, SAO has been found to be dominant over aceticlastic methanogenesis under extreme conditions such as high ammonia or high fatty acid concentrations and high temperatures. Here, we investigated the pathway of acetate utilization and the mechanism of SAO in haloalkaline soda lakes that have extremely high soda concentrations and pH. Enrichment cultures of SAOB together with a methanogenic (M-SAO) or sulfate-reducing (S-SAO) syntrophic partner showed that hydrogen is an important interspecies electron carrier. Metagenome analysis of the M-SAO enrichment culture showed that "*Candidatus* Syntrophonatronum acetioxidans" is the dominant SAOB, and its genome contained all genes necessary for operating the Wood Ljungdahl pathway in reverse. The genome contained an F_1F_0 ATP synthase that uses a proton motive force (pmf), but it also contained an energy conserving hydrogenase (Ehb) that pumps out Na^+ instead of H^+ while consuming intracellular H^+ to form H_2. This simultaneously generates a pmf while pumping out Na^+, which is probably an adaptation to the high Na^+ concentrations in soda lakes. High-throughput 16S rRNA gene sequencing results of five different soda lake sediments showed that "*Candidatus* Syntrophonatronum acetioxidans" related sequences were up to 1.3% of all reads and the overarching *Syntrophomonadaceae* family was highly abundant (up to 24.5% of total reads). Known aceticlastic methanogenic genera were mostly absent. These results show that SAO, and syntrophy in general, is an important process in soda lakes which is probably a result of the extreme haloalkaline conditions.